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Full Length Research Paper

Suicide incidents in India in relation with solar activity parameters and cosmic ray intensity (1989 to 2011)

P. L. Verma

Department of Physics, Government Vivekan and P. G. College, Maihar Satna M. P. India.
E-mail: plverma2010@gmail.com.

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We studied the relation between the death due to suicide in India and of various solar activity (SA) parameters, for example, sunspot numbers (SSN), solar flare index (SFI), coronal index (CI) and cosmic ray intensity (CRI), observed during the period of 1989 to 2011. It is seen that the number of suicide incidents of male, female, and average is well correlated with yearly average of SSN, SFI, and CI and positively correlated with CRI. We have found good medium negative correlation with correlation coefficient -0.54, -0.53, and -0.54 between the average of SSN and male, female, total, and rate of suicide incidents occurring yearly. Negative correlation with correlation -0.55, -0.61, -0.57, and -0.52 had also been found between CI and female, total, and rate of suicide (per 1000000) suicide incidents. Further we have determined large negative correlation with correlation coefficient -0.65, -0.69, -0.67, and -0.62 between SFI and male, female, total, rate of suicide (per 1000000) suicide incidents. Positive correlation with correlation coefficient 0.59, 0.66, 0.61, and 0.58 had been found between yearly average of CRI and male, female, total, and rate of suicide (per 1000000) suicide incidents.

Key words: Sunspot numbers, solar flare index (SFI), coronal index (CI), cosmic ray intensity (CRI), suicide and suicide rate in India.

INTRODUCTION

The state of near-earth space environment is governed by the sun and is very dynamic on all spatial and temporal scales. The sun also poses a health and safety threat to humans (Ptitsyna et al., 1998) and all kinds of human activities. The geomagnetic field which protects the earth from solar wind and cosmic rays is also essential to the evolution of life. There is an increasing amount of evidence linking biological effects to solar and geomagnetic disturbances and cosmic ray variations.

Recently, the links between life threatening cardiac arrhythmias, sudden cardiac deaths, and the level of environmental physical activity factors like geomagnetic activity and cosmic ray and high energy proton flux have been studied (Stoupel et al., 2006). A new field, called 'Clinical Cosmobiology, is slowly developing. This field studies the relationship between the frequencies of total deaths, cardiac arrhythmias, occurrence of acute myocardial infarction, risk related cardiovascular parameters, deaths from cardiovascular diseases, temporal distribution of sudden cardiac death, stroke, life threatening cardiac arrhythmias, homicide, and suicide and the level of major environmental physical activity factors (Stoupel et al., 2006). There are numerous indications that solar activity (SA) and solar activity variability-driven time variations of the geomagnetic field can be hazardous in relation to human health state and safety (Palmer et al., 2006). Several researches have indicated that, changes in space weather may have a negative impact on human health and physiological state through the influence of geomagnetic disturbances on the human brain's functional state (Babayev and Allahverdiyeva, 2007). Studies conducted in different places on the globe (Russia, Germany, Hungary, Japan, Poland, Azerbaijan, Israel, Lithuania, etc.) have shown correlations between high solar and geomagnetic activity and increased traffic accidents.

Disturbances and variations in space weather (heliogeophysical and cosmic ray activity) play a significant role in traffic accidents as a trigger factor, increasing the risk of traffic accidents. Over the last years, many studies have been carried out concerning the possible effect that solar and geomagnetic activity might have on human physiological state (Dimitrova, 2006; Dorman, 2005) and inferred that human

physiological status is influenced by environmental factor changes requiring from the organism and its nervous system a large range of adaptation reactions, which are decreased in case of different diseases (Palmer et al., 2006). Although, the solar or geomagnetic variations could not be solely responsible for all the changes or fluctuations of physiological parameters measured in a human organism but the geomagnetic variations of solar origin can influence at some level the human health and cause a chain of serious problems (Palmer et al., 2006).

It has been shown that cardiovascular diseases, like myocardial infarction and brain strokes, also brain malfunctions of man related origin can be influenced by space weather parameters, both in short (during Forbush decreases events) and long term scale. In the last decades, many scientists have worked on the impact of space weather parameters through the geomagnetic field on different diseases (Dimitrova et al., 2004). It has been revealed that cardiovascular circulatory nervous and other functional systems react under changes of geophysical factors (Cornelissen et al., 2004). It has long been claimed that geomagnetic storms and other electromagnetic variations are associated with changes in the incidence of various diseases myocardial infractions and strokes (Halberg et al., 2000). Some evidence had also been accumulated on the association between geomagnetic disturbances and increases in work and traffic accidents (Dorman, 2005; Ptitsyna et al., 1996; Reiter, 1955). Cosmic ray Forbush decreases, which are connected to interplanetary disturbance can be used as indicators of the relationship between the geomagnetic field fluctuations and health parameters (Dorman et al., 2001). The most important results are those concerning cardiovascular diseases and diseases of the nervous system, especially strokes, myocardial infarctions and traffic accidents as well (Dorman et al., 1999; Ptitsyna et al., 1996; Villoresi et al., 1994a, 1994b; 1998). Charmaine and Michael (2003) have studied geomagnetic activity and suicide rates. They have correlated geomagnetic activity with suicide rates for the period of 13 years from January 1980 to 1992. They have found a significant correlation (r = 0.6964) between the mean total of suicides and the mean average of geomagnetic storm activity. This correlation have been found true of both male (r = 0. 6301) and female (r= 0.7544). The aim of this study is to explore links between suicide death, Solar (SA), and Cosmic Ray activity (CRA).

EXPERIMENTAL DATA

In this study number of suicide incident of male, female, total, and rate of suicide (per 1000000) in India, yearly average of SA parameters sunspot number (SSN), solar flare index (SFI), coronal index (CI), and cosmic ray intensity (CRI) for the period of 1989 to 2011 had been taken into consideration. The data of suicide incident has been taken from the National Crime Records Burea records (NCRB) 2011, ministry of home affairs of India. The data of SA parameters SSN, SFI and CI were taken from the STP solar data (www.ngdc.noaa.gov/stp/solardataservices). For the data of CRI, yearly average count rates of Oulu super neutron monitor had been used.

Method of analysis and results

In this study statistical method correlation had been used. The correlation is one of the most common and most useful statistics. A correlation is a single number that describes the degree of relationship between two variables. Correlation coefficient, symbolized as *r*, is a numerical summary of a bivariate relationship and can range from -1.00 to +1.00. Any *r* that is positive indicates a direct or positive relationship between two measured variables. Negative r indicates indirect or inverse relationship.
The formula for the correlation is:

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - (\sum X)^2\right]\left[N\sum Y^2 - (\sum Y)^2\right]}}$$

Where, N = number of pairs of scores, $\sum XY$ = sum of the products of paired scores, $\sum X$ = sum of x scores, $\sum Y$ = sum of y scores, $\sum X^2$ = sum of squared scores, $\sum Y^2$ = sum of squared score

The scale of correlation coefficient is:

0.8 to 1.0 or -0.8 to -1.0 (very large relationship)
0.6 to 0.8 or -0.6 to -0.8 (large relationship)
0.4 to 0.6 or -0.4 to -0.6 (good medium relationship)
0.2 to 0.4 or 0.2 to -0.4 (weak relationship)
0.0 to 0.2 or 0.0 to -0.2 (weak or no relationship)

RESULTS

From the data analysis of Table 1 and Figures 1, 2 and 3, it is inferred that the suicide incidents are related to yearly average of SSN, SFI, and SCI. About solar maximum, these incidents have been found comparatively low in comparison to corresponding solar minimum Figures 1, 2, and 3.

Data analysis also shows that suicide incidents are related to yearly average of cosmic ray intensity. About solar maximum this event have found maximum and at solar minimum these events are minimum Figure 4. From the statistical analysis of yearly average of SSN, SFI, CI, CRI, and male, female, total and rate of suicide incidents, the following results have been obtained:

a) Good medium negative correlation with correlation coefficient -0.54, -0.53, -0.54 between yearly average of SSN and male, female, total, and rate (per 1000000) suicide incidents.
b) Negative correlation with correlation -0.55, -0.61, -0.57 and -0.52 between CI and female, total, rate (per 1000000) suicide incidents.

Table 1. Shows yearly suicide incidents in India and their association with sunspot number, solar flare index, coronal index and cosmic ray activity for the period of 1989 to 2011.

Years	Suicide incidents		Total	Suicide rate (per 1000000)	Yearly average of sunspot numbers	Yearly average of solar flare	Yearly average of coronal index	Yearly average of cosmic ray count rate
	Male	Female						
1989	40212	28532	68774	8.47	157.6	17.39	17.52	5480
1990	43451	30460	73911	8.94	142.6	12.2	15.99	5416
1991	46324	32126	78450	9.23	145.7	15.16	14.74	5432
1992	47481	32668	80149	9.24	94.3	7.74	10.97	5922
1993	49851	345393	84244	9.53	54.6	4.23	6.88	6203
1994	52752	36443	89195	9.91	29.9	1.58	4.36	6280
1995	52357	36821	89178	9.74	17.5	0.86	2.86	6387
1996	51206	37035	88241	9.47	8.6	0.42	1.98	6503
1997	56281	39548	95829	10.03	21.5	1.01	3.08	6545
1998	61686	43027	10713	10.79	64.3	4	6.35	6399
1999	65488	45099	110587	11.21	93.3	6.39	8.93	6203
2000	66032	42561	108593	10.8	119.6	7.61	9.74	5784
2001	66314	42192	108506	10.6	110.9	6.8	10.53	5889
2002	69332	41085	110417	10.5	104.1	4.56	10.14	5806
2003	70221	40630	110851	10.4	63.56	3.46	6.21	5759
2004	72651	41046	113697	10.5	40.44	1.6	6.4	6093
2005	72916	40998	113914	10.3	29.78	1.91	4.64	6156
2006	75702	42410	118112	10.5	15.18	0.54	4.54	6478
2007	79295	43342	122637	10.8	7.5	0.47	2.11	6632
2008	80544	44473	125017	10.8	2.86	0.03	1.6	6662
2009	81471	45680	127151	10.9	3.09	0.02	Nd	6804
2010	87180	47419	134599	11.4	16.5	0.39	Nd	6623
2011	87839	47746	135585	12.2	55.58	Nd	Nd	6416

c) Large negative correlation with correlation coefficient -0.65,-0.69,-0.67,-0.62 between SFI and male, female, total, and rate (per 1000000) suicide incidents.

d) Positive correlation with correlation coefficient 0.59, 0.66, 0.61 and 0.58 between yearly average of CRI and male, female, total, and rate (per 1000000) suicide incidents.

DISCUSSION

Previous studies have confirmed that, suicide rates are found to have a highly significant adaptive homeostatic relationship to the monthly SSN. It has been found that the Schumann resonance signal which is modulated by the SA and is detected by the human brain and modulates the Melatonin output is related to serious depression and suicide. The Schumann Resonance signal provides a homeostatic control of brain activity (Stoupel et al., 2011). Therefore increased and decreased Schumann resonance intensity, produced by increased and decreased SA, is shown to produce homeostatic relationships with anxiety, suicide. This study

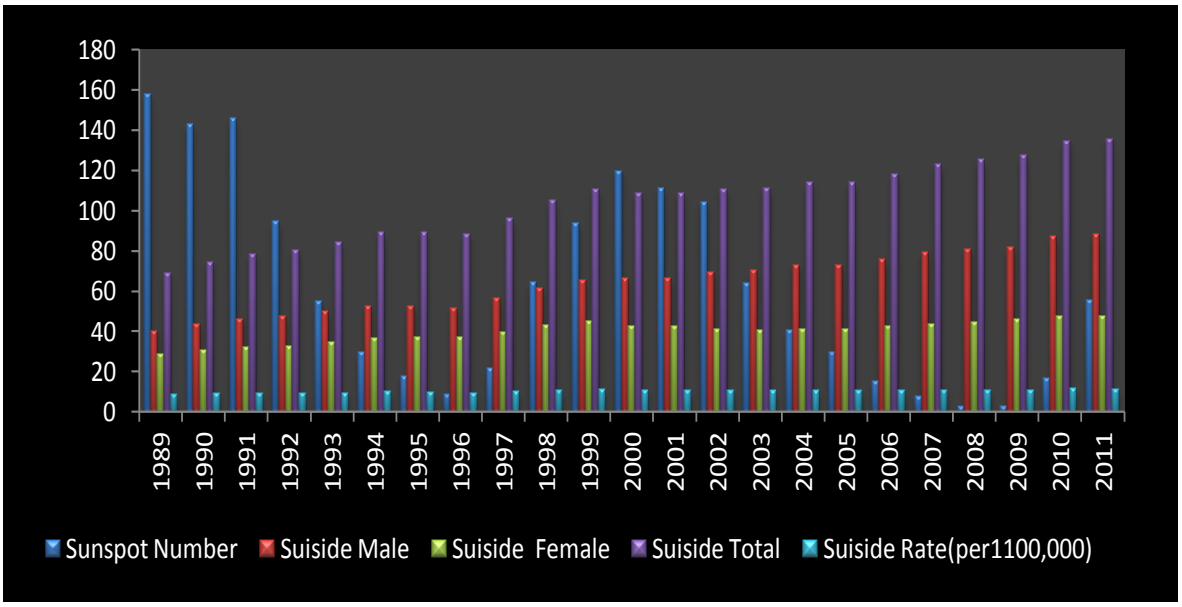

Figure 1. Shows the variation of male, female, total and rate of suicide incidents with yearly average of SSN during the period of 1986 to 2011.

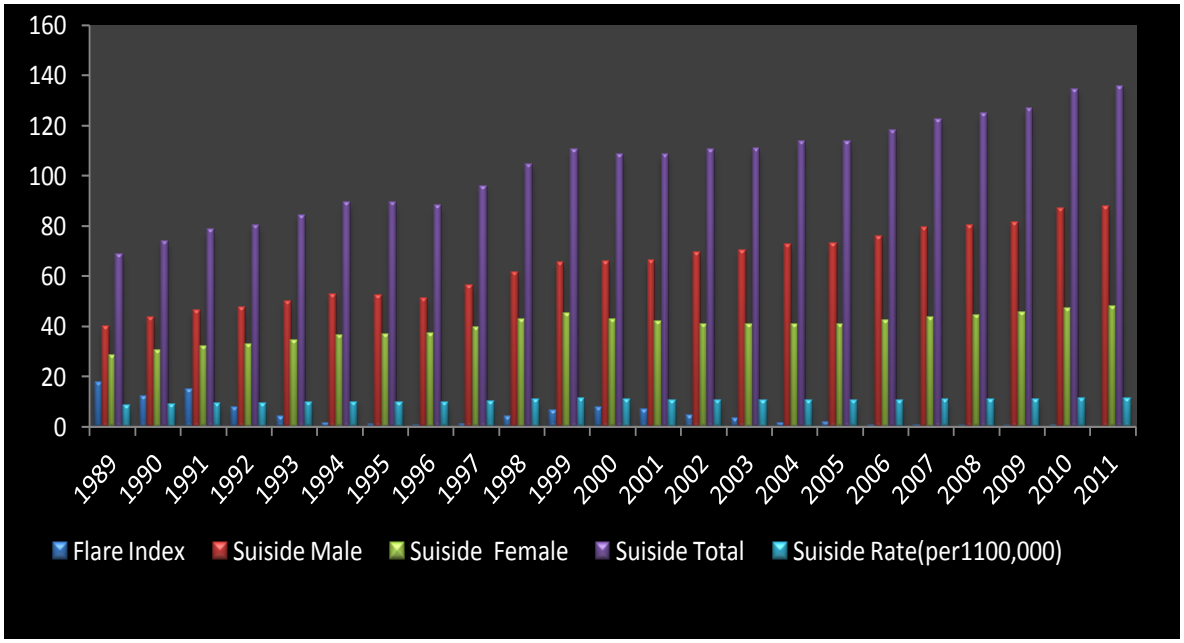

Figure 2. Shows the variation of male, female, total and rate of suicide incidents with yearly average of SRI during the period of 1986 to 2011.

has found significant homeostatic relationships between the monthly mean SSN and the suicide rates in Christchurch, New Zealand. An adaptive response appears from high, middle, low, and very low SA over the 11 years sunspot cycle from 1988 to 1998.

The long term study confirms results of number of previous observations on links between timing of human death and environmental physical factors (Halberg et al., 2000; Nuzhdina, 1998; Oraevskij et al., 1998; Stoupel, 1976; Stoupel and Shimshoni, 1991; Stoupel, 2002a, b;

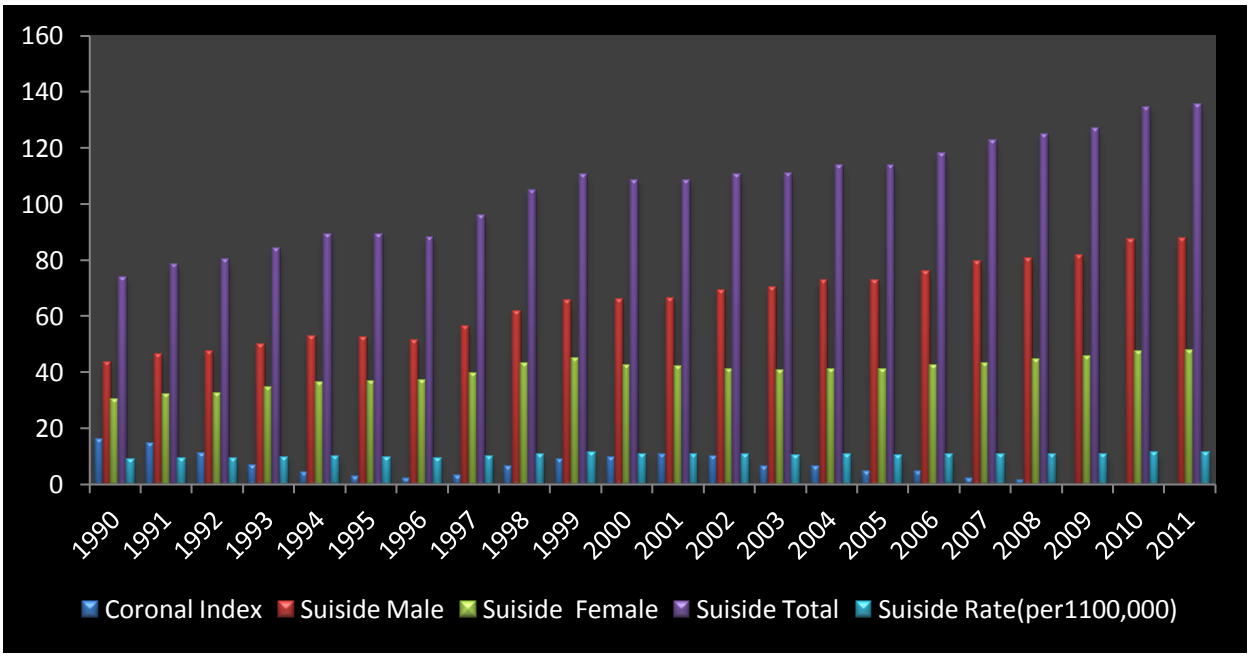

Figure 3. Shows the variation of male, female, total and rate of suicide incidents with yearly average of solar CI during the period of 1986 to 2011.

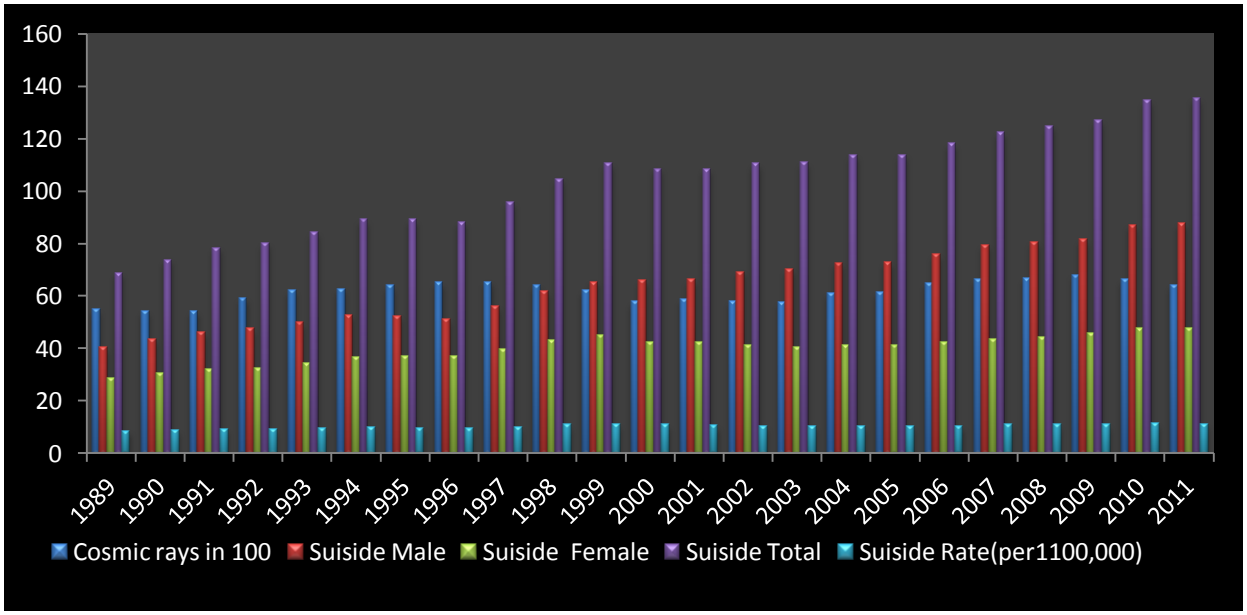

Figure 4. Shows variation of male, female, total and rate of suicide incidents with yearly average of CRI during the period of 1986 to 2011.

Stoupel et al., 2006). Results of this study also shows that, there is strong relationship between mortality due to suicide and SA parameters (SSN, SFI, and CI) and CRA. The significant correlation with correlation coefficient -0.54, -0.53, -0.54 between yearly average of SSN and male, female and total suicide death; -0.65, -0.69, -0.67, between SFI and male, female and total suicide death; -0.55, -0.61, -0.57, between CI and male, female and total suicide death; 0.59, 0.66, 0.61 between yearly average of cosmic ray count rate and male female and total suicide

death confirms the relationship of SA parameter, CRA and suicide death. Similar kind of study have been performed by Stoupel et al. (2011) by analyzing data of suicide incidence which occurred in Republic of Lithuania during the period of 1990 to 2009 with SA parameters SSN and CRA and confirmed relationship between suicide incidence and SA parameters and SRA.

Conclusion

SA parameters SSN, SFI, CI, and CRI are significantly connected with yearly suicide incidence during the period of 1989 to 2011. In women, the suicide death is more than in men. The clarification of the mechanisms of action of SA and cosmophysical factors on humans and biological objects needed more detail studies.

REFERENCES

Babayev ES, Allahverdiyeva AA (2007). Effects of geomagnetic activity variations on the physiological and psychological state of functionally healthy humans. Adv. Space Res. 40:1941.

Charmaine G, Michael B (2003). The effect of Geomagnetic storms on suicide. South Afr. Psychiatry Rev. P. 6.

Cornelissen G, Halberg F, Breus T, Syutkina EV, Baevsky R, Weydahl A, Watanabe Y, Otsuka K, Siegelova J, Fiser B, Bakken E.E (2004). Non-photic Solar Associations of heart rate Variability and Myocardial Infarction. J. Atm. Solar-Terr. Phys. 64:707.

Dimitrova S (2006). Relationship between Human Physiological Parameters and Geomagnetic Variations of Solar Origin. Adv. Space Res. 37:1251.

Dimitrova S, Stoilova I, Cholakov I (2004). Influence of Local Geomagnetic Storms on Arterial Blood Pressure. Bioelectromagnetics 25(6):408.

Dorman LI (2005). Space Weather and Dangerous Phenomena on the Earth: Principles of Great Geomagnetic Storms Forecasting by Online Cosmic Ray Data. Ann. Geophys. 23:2997.

Dorman LI, Iucci N, Ptitsyna NG, Villoresi G (1999). Cosmic ray Forbush decreases as indicators of space dangerous phenomena and possibleuse of cosmic ray data for their prediction. Proc. 26th ICRC 6:476.

Dorman LI, Iucci N, Ptitsyna NG, Villoresi G (2001). Cosmic rays as indicator of space weather influence on frequency of infract myocardial, brain strokes, car and train accidents. Proc. 27th ICRC (Hamburg) P. 3511.

Halberg F, Cornelissen G, Chen CH, Katinas CS, Watanabe Y, Otsuka K, Herold M, Loeckinger A, Kreze E, Perfetto F, Tarquini R, Maggioni C, Schwartzkopff O (2000). Chronobiology: The time structures, chronomes gauge, aging, diseases risk and the cosmos." J. Anti-Aging Med. 3:67.

Halberg F, Cornelissen G, Otsuka K, Watanabe Y, Katinas GS, Burioka N, Delyukov A, Gorgo Y, Zhao ZY, Weydahl A, Sothern RB, Siegelova J, Fiser B, Dusek J, Syutkina EV, Perfetto F, Tarquini R, Singh RB, Rhees B, Lofstrom D, Lofstrom P, Johnson PWC, Schwartzkopff O (2000). Cross-spectrally coherent ~ 10:5 and 21-year biological and physical cycles, magnetic storms and myocardial infarctions. Neuroendocrinol. Lett. 21:233.

Nuzhdina MA (1998). Effect of natural factors on the occurrence of cardiovascular diseases". Biofizika 43:640.

Oraevskij VN, Breus TK, Baevskij BM, Rapoport SI, Petrov VM, Barsukova Zh. V (1998). Effect of geomagnetic activity on the functional status of the body. Biophisika 43:819.

Palmer SJ, Rycroft MJ, Cermack M (2006). Solar and geomagnetic activity, extremely low frequency magnetic and electric fields and human health at the Earth's surface. Surv. Geophys. 27:557.

Ptitsyna NG, Villoresi G, Dorman LI, Iucci N, Tiasto MI (1998). Natural and Man-made Low-frequency Magnetic Fieldsas a Potential Health Hazard. UFN (Uspekhi PhysicheskikhNauk) 168(7):767.

Ptitsyna NG, Villoresi G, Kopytenko YA, Kudrin VA, Tyasto MI, Kopytenko EA, Iucci N, Voronov PM, Zaitsev DB (1996). Coronary heart diseases: an assessment of risk associated with work exposure to ultra low frequency magnetic fields. Bioelectromagnetics 17:436.

Reiter R (1955). Bio-meteorologie auf physikalischer basis. Phys. Blatter 11:453.

Stoupel E, Babayev ES, Mustafa FR, Abramson E, Israelevich P, Sulkes J (2006). Clinical Cosmobiology – Sudden Cardiac Death and Daily / Monthly Geomagnetic, Cosmic Ray and Solar Activity - the Baku Study "(2003-2005)." Sun Geosphere 1(2):13.

Stoupel E, Ramune K, Jadviga P, Skirmante S, Evgeny A, Peter I, Jaqueline S (2011). Twenty years study of solar, geomagnetic, cosmic ray activity links with monthly deaths number" doi:10.4236/jbise.2011.46054 Published Online June 2011 (http://www.SciRP.org/journal/jbise/).Published Online June 2011 in SciRes. http://www.scirp.org/journal/JBiSE.

Stoupel E (1976). Forecasting in cardiology. J. Wiley & Sons, New York. P. 141.

Stoupel E (2002).The equilibrium paradigm in clinical cosmobiology. J. Basic Clin. Physiol. Pharmacol. 13:255.

Stoupel E, Shimshoni M (1991). Hospital cardiovascular deaths and total distribution of deaths in 180 consecutive months with different cosmic physical activity: A correlative study (1974-1988). Int. J. Biometeorol. 35:6.

Stoupel E (2002). The effect of geomagnetic activity on cardiovascular parameters. Biomed Pharmacother 56:247.

Stoupel E, Babayev E, Mustafa F, Abramson E, Israelevich P, Sulkes J (2006). Clinical cosmobiology—sudden cardiac death and daily/monthly geomagnetic, cosmic ray, and solar activity—the Baku study, "2003-2005". Sun Geosphere 1:13.

Villoresi G, Ptitsyna NG, Tiasto MI, Iucci N (1998). Myocardial Infarct and Geomagnetic Disturbances: Analysis of Data on Morbidity and Mortality." Biofizika 43(4):623.

Villoresi G, Breus TK, Iucci N, Dorman LI, Rapoport SI (1994a). The influence of geophysical and social effects on the incidences of clinically important pathologies (Moscow 1979–1981)." Phys. Med. 10:79.

Villoresi G, Kopytenko, YA, Ptitsyana NG, Tyasto MI, Kopytenko EA, Iucci N, Voronov PM (1994b). The influence of geomagnetic storms and man-made magnetic field disturbances on the incidence of myocardial infraction in St. Petersburg (Russia). Phys. Med. 10:107.